

**What Is Claimed Is:**

1           1.       A method for supporting read-only objects within an object-  
2 addressed memory hierarchy, comprising:  
3           receiving a request to access an object, wherein the request includes an  
4 object identifier for the object that is used to reference the object within the  
5 object-addressed memory hierarchy;  
6           using the object identifier to retrieve an object table entry associated with  
7 the object;  
8           if the request is a write request,  
9                       examining a read-only indicator within the object table  
10                  entry,  
11                       if the read-only indicator specifies that the object is a read-  
12                  only object, performing a corrective action to deal with the fact that  
13                  the write request is directed to a read-only object.

1           2.       The method of claim 1, wherein if the request is a read request, the  
2 method further comprises using a physical address from the object table entry to  
3 access the object in main memory.

1           3.       The method of claim 1, wherein performing the corrective action  
2 can involve causing a fault handler in the requesting processor to perform the  
3 corrective action.

1           4.       The method of claim 1, wherein performing the corrective action  
2 can involve:

3           obtaining a writable copy of the object, clearing the read-only indicator to  
4           indicate that the object is no longer read-only, and updating the writable copy of  
5           the object with data from the write request;  
6           updating a remotely located master copy of the object with data from the  
7           write request;  
8           terminating the requesting process because the write request is not  
9           allowed; and  
10          if the request is directed to a debugging breakpoint, pausing the requesting  
11          process and clearing the read-only indicator.

1           5.       The method of claim 1, wherein the request to access the object is  
2           received at a translator that translates between object identifiers (used to reference  
3           objects in an object cache) and physical addresses (used to address objects in main  
4           memory).

1           6.       The method of claim 5,  
2           wherein prior to receiving the request at the translator, the request is  
3           initially directed to the object cache;  
4           wherein if the request causes a hit in the object cache, the object is  
5           accessed in the object cache and the request is not sent to the translator; and  
6           wherein if the request causes a miss in the object cache, the request is sent  
7           to the translator.

1           7.       The method of claim 6, further comprising making a given object  
2           read-only by:  
3           setting a read-only indicator associated with the given object to indicate  
4           that the given object is read-only;

5 causing all object caches within a local cache-coherent domain to flush  
6 any modified cache lines of the given object out to main memory;  
7 whereby subsequent upgrades of the given object from read-only status to  
8 writable or modified status in any caches within the local cache-coherent domain  
9 must go through a translator.

1 8. The method of claim 7, wherein causing all object caches within  
2 the local cache-coherent domain to flush any modified cache lines of the given  
3 object out to main memory involves executing a read-with-intent-to-only-read  
4 (RWITOR) instruction on each cache line of the given object.

1 9. The method of claim 7, wherein the given object can be made read-  
2 only in response to a request received from outside the local cache-coherent  
3 domain.

1 10. The method of claim 5, wherein the translator includes hardware to  
2 translate between object identifiers and physical addresses.

1 11. An apparatus that supports read-only objects within an object-  
2 addressed memory hierarchy, comprising:  
3 a receiving mechanism configured to receive a request to access an object,  
4 wherein the request includes an object identifier for the object that is used to  
5 reference the object within the object-addressed memory hierarchy;  
6 a translation mechanism configured to use the object identifier to retrieve  
7 an object table entry associated with the object; and  
8 a corrective action mechanism, wherein if the request is a write request,  
9 the corrective action mechanism is configured to,

10                   examine a read-only indicator within the object table entry,  
11                   and  
12                   if the read-only indicator specifies that the object is a read-  
13                   only object, to perform a corrective action to deal with the fact that  
14                   the write request is directed to a read-only object.

1           12.    The apparatus of claim 11, wherein if the request is a read request,  
2   the translation mechanism is additionally configured to use a physical address  
3   from the object table entry to access the object in main memory.

1           13.    The apparatus of claim 11, wherein the corrective action  
2   mechanism is configured to cause a fault handler in the requesting processor to  
3   perform the corrective action.

1           14.    The apparatus of claim 11, wherein performing the corrective  
2   action can involve:  
3           obtaining a writable copy of the object, clearing the read-only indicator to  
4   indicate that the object is no longer read-only, and updating the writable copy of  
5   the object with data from the write request;  
6           updating a remotely located master copy of the object with data from the  
7   write request;  
8           terminating the requesting process because the write request is not  
9   allowed; and  
10          if the request is directed to a debugging breakpoint, pausing the requesting  
11   process and clearing the read-only indicator.

1           15.     The apparatus of claim 11, wherein the receiving mechanism and  
2     the translation mechanism reside within a translator that translates between object  
3     identifiers (used to reference objects in an object cache) and physical addresses  
4     (used to address objects in main memory).

1           16.     The apparatus of claim 15, wherein the apparatus includes the  
2     object cache;  
3                 wherein prior to receiving the request at the translator, the request is  
4     initially directed to the object cache;  
5                 wherein if the request causes a hit in the object cache, the object is  
6     accessed in the object cache and the request is not sent to the translator; and  
7                 wherein if the request causes a miss in the object cache, the request is sent  
8     to the translator.

1           17.     The apparatus of claim 16, further comprising a read-only  
2     configuration mechanism configured to make a given object read-only by:  
3                 setting a read-only indicator associated with the given object to indicate  
4     that the given object is read-only; and  
5                 causing all object caches within a local cache-coherent domain to flush  
6     any modified cache lines of the given object out to main memory;  
7                 whereby subsequent upgrades of the given object from read-only status to  
8     writable or modified status in any caches within the local cache-coherent domain  
9     must go through a translator.

1           18.     The apparatus of claim 17, wherein the read-only configuration  
2     mechanism causes all object caches within the local cache-coherent domain to  
3     flush any modified cache lines of the given object out to main memory by

4     executing a read-with-intent-to-only-read (RWITOR) instruction on each cache  
5     line of the given object.

1           19.     The apparatus of claim 17, wherein the read-only configuration  
2     mechanism makes the given object read-only in response to a request received  
3     from outside the local cache-coherent domain.

1           20.     The apparatus of claim 15, wherein the translator includes  
2     hardware to translate between object identifiers and physical addresses.

1           21.     A computer system that supports read-only objects within an  
2     object-addressed memory hierarchy, comprising:  
3           a processor;  
4           the object-addressed memory hierarchy;  
5           an object cache within the object-addressed memory hierarchy;  
6           a translator that translates between object identifiers, used to address  
7     objects in the object cache, and physical addresses, used to address objects in  
8     main memory;  
9           a receiving mechanism within the translator configured to receive a  
10    request to access an object, wherein the request includes an object identifier for  
11    the object that is used to reference the object within the object-addressed memory  
12    hierarchy;  
13          a translation mechanism within the translator configured to use the object  
14    identifier to retrieve an object table entry associated with the object; and  
15          a corrective action mechanism, wherein if the request is a write request,  
16    the corrective action mechanism is configured to,

17                               examine a read-only indicator within the object table entry,  
18                               and  
19                               if the read-only indicator specifies that the object is a read-  
20                               only object, to perform a corrective action to deal with the fact that  
21                               the write request is directed to a read-only object.